Atty. Dkt. No.: 77056/341

U.S. PATENT APPLICATION

for

Method and Apparatus for Relieving Stress in a Fabric

Inventors: Bryan K. Ruggles
Stuart F. Matthews

Method and Apparatus for Relieving Stress in a Fabric

FIELD OF THIS INVENTION

The present invention relates generally to the field of window coverings. More particularly, the present invention relates to a method and apparatus for relieving stresses in light control window covering and other fabrics.

BACKGROUND OF THE INVENTION

One type of light control window covering typically includes front and rear portions comprising a sheer material that are coupled to each other by a plurality of vanes. The light control window covering is often movable from an open position, in which the vanes are horizontal and light is capable of passing therethrough, to a light blocking position, in which the vanes are substantially vertical and light is hindered from passing through the window covering.

Several methods have been developed for manufacturing light control window coverings. For example, U.S. Patent No. 3,384,519 to Froget discloses a method of welding the marginal edges of a plurality of vanes to two layers of material. First, each vane is welded to one face of the first layer of material. As each vane is welded to the first layer of material, the first layer and the welded vane are wound onto a reel. After all of the vanes have been welded to the first layer of material and wound onto a reel, the combination is then unwound such that the free edge of each vane comes into contact with a second layer of material. The free edge is then welded to the second layer of material. In this manner a light-control window covering is formed with one face of the vane being welded at its marginal edge to the first layer and the second face of the vane being welded at its second marginal edge to the second layer.

U.S. Patent No. 5,313,999 to Colson et al. describes a method and apparatus for forming a light-control window covering, in which one side of individual vanes are attached with adhesive to a first continuous sheet of material and the other side of the vanes are then attached with adhesive to a second continuous sheet of material. The first and second sides of each vane are attached to the first and second sheets in a continuous line. Both the Froget and Colson patents require that the vanes be attached to the first and second sheets individually, one at a time.

U.S. Patent No. 5,228,936 to Goodhue describes a method and apparatus for forming a light-control window covering, in which all of the vanes are attached with adhesive to the first and second sheets simultaneously. As in Froget and Colson, one side of each vane is attached to a first sheet and the other side of each vane is attached to a second sheet. Since, the vanes are applied to the first and second sheets side by side, the vanes do not overlap when the window covering is in the light-blocking position. As a result, light is likely to pass through the spaces between adjacent vanes.

U.S. Patent No.5,888,639 to Green et al. discloses a method and apparatus for forming a light-control window covering formed by continuously welding three substrates of material together to form a three-substrate web having first and second light-control regions and a center vane or opaque region located therebetween. Portions of the three-substrate web are laterally offset from one another and adhesively attached to form a light-control window covering.

U.S. Patent Nos. 5,846,360; 5,885,409; and 5,891,208, to Gill, an inventor common to the instant application, disclose a method and apparatus for manufacturing a multilayer filter by attaching first and

second filter layers to a plurality of ribbons utilizing ultrasonic welding equipment.

One disadvantage of many of these methods of manufacturing light control window coverings, however, is that the light control window covering is often bent, creased or formed with puckers or other stresses or imperfections during the manufacturing process. These stresses hinder the overall aesthetic quality of the window covering. It would therefore be desirable to develop a method and apparatus for treating light control window coverings and other fabrics such that creases and other stresses and imperfections are removed or relieved in an easy and efficient manner.

SUMMARY OF THE INVENTION

One embodiment of this invention relates to a method and apparatus of relieving such stresses from a light control window covering or other fabric by using a stress relief process. The light control window covering comprises first and second sheets of sheer material coupled to each other, via ultrasonic welding or another method, by a plurality of vanes. Each vane has first and second longitudinal edges. The first longitudinal edge of each vane is coupled to the first sheet of sheer material, while the second longitudinal edge of each vane is coupled to the second sheet of sheer material.

The assembled light control window covering is fed into a stress relief apparatus along a pathway such that the first and second longitudinal edges of each vane is oriented substantially parallel to the pathway. A tentering frame including a plurality of pins is used to grab the first and second sheets of sheer material and apply tension to the window covering in a direction substantially perpendicular to the pathway. A plurality of nip units located at different points along the

pathway are used to apply tension to the window covering in a direction substantially parallel to the pathway. A drive mechanism carries the window covering along the pathway over a metal platen and past a plurality of heating units. The heating units apply a controlled amount of heat to the tensioned window covering, relieving stresses and removing creases and imperfections. The tension on the window covering in the direction substantially parallel to the pathway is removed once the window covering passes the final nip unit, while the tension in the direction substantially perpendicular to the pathway is removed at the end of the tentering frame, as the light control window covering is lifted off the tentering frame with the assistance of an idler.

Another embodiment of this invention involves the use of a method and apparatus for relieving stress in a light control window covering or other fabric to remove imperfections from the fabric. The window covering comprises two sheets of sheer material that are coupled to each other by a plurality of vanes. The window covering is fed into a stress relieving apparatus along a pathway and is tensioned in both first and second directions that are substantially orthogonal to each other. The window covering is carried along the pathway across a platen surrounded by heating units which are used to remove the creases or imperfections from the window covering. A conveyor belt mechanism is used to carry the center portion of the window covering across the heating units, preventing or limiting the amount of drag in the center portion of the window covering. After the window covering passes through the region adjacent to the heating units, the tension is removed from the window covering, and the window covering is fed out of the stress relieving device.

These and other benefits and features of the present invention will be apparent upon consideration of the following detailed

description of preferred embodiments thereof, presented in connection with the following drawings in which like reference numerals identify like elements throughout.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side view of a stress relief apparatus according to one embodiment of the invention.

FIG. 2 is a top view of the stress relief apparatus of FIG. 1;

FIG. 3 is a plan view of an entrance portion of the stress relief apparatus of FIG. 1;

FIG 4 is a cross-sectional view of a portion of the stress relief apparatus taken along lines 4-4 of FIG. 3;

FIG. 5 is a cross-sectional view of a portion of the stress relief apparatus taken along lines 5-5 of FIG. 3;

FIG. 6 is a segmented top view of the sheets of sheer material and vanes of a light control window covering while in contact with the tentering frame;

FIG. 7 is a plan view of a central portion of the stress relief apparatus of FIG.1;

FIG. 8 is a cross-sectional view of a portion of the stress relief apparatus taken along lines 8-8 of FIG. 7;

FIG. 9 is a plan view of the cooling portion of the stress relief apparatus of FIG. 1;

FIG. 10 is a plan view of a portion of the stress relief apparatus wherein the window covering is removed from the tensioning frame;

FIG. 11 is a perspective view of a light control window covering according to one embodiment of the invention;

FIG. 12 is a plan view of an untensioned portion of the window covering;

FIG. 13 is a plan view of a partially tensioned window covering;

FIG. 14 is a plan view of a fully tensioned window covering for use in the stress relief apparatus; and

FIG. 15 is a plan view of a central portion of a stress relief apparatus according to an alternate embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

Referring to FIG. 1, a light control window covering 82 or other fabric composite is fed into a device, shown generally at 80, for relieving stress in the window covering 82. Alternatively, fabrics other than light control window coverings could also be used in the device in accordance with the methods described herein.

According to one embodiment of the invention and as shown in FIG. 11, the light control window covering 82 comprises a first sheet of sheer material 100 and a second sheet of sheer material 102. The first and second sheets of sheer material 100 and 102 are disposed substantially parallel to each other. The first sheet of sheer material 100 and the second sheet of sheer material 102 are coupled to each other by a plurality of vanes 104. In an alternate embodiment of the invention, a plurality of strips (not shown) are used instead the first sheet of sheer material 100 and the second sheet of sheer material 102. In this alternate embodiment, the strips are also coupled to each other by the plurality of vanes 104.

The vanes 104, according to one embodiment of the invention, are ultrasonically welded to the first and second sheets of sheer material 100 and 102. Each vane 104 includes a first longitudinal

edge 106 and a second longitudinal edge 108. Each vane 104 is formed in a "U" shape with the first longitudinal edge 106 ultrasonically welded to an inner side 110 of the first sheet of sheer material 100 and the second longitudinal edge 108 ultrasonically welded to an inner side 112 of the second sheet of sheer material 102. In one embodiment of the invention, each vane 104 comprises an opaque material.

The term "sheer material" as used herein includes woven, non-woven, natural and synthetic materials with the ability to pass at least a portion of light there through. In one embodiment of the invention, the first sheet of sheer material 100 is a knit sheer having diamond-shaped interstices wherein the first sheet of sheer material 100 can be formed from either a single or multi filament yarn. The second sheet of sheer material 102 is also a knit sheer according to one embodiment of the invention and preferably has different-shaped interstices than the first sheet of sheer material 100 in order to minimize the moiré appearance. In one particular embodiment of the invention, the second sheet of sheer material 102 includes square-shaped interstices. The individual vanes 104 are preferably an opaque knit material having a similar elongation to the first and second sheets of sheer material 100 and 102. It is also possible, however, for the vanes 104 to be formed from a woven or non-woven polyester or a film.

Although in one embodiment of the invention the individual vanes 104 are ultrasonically welded to the first and second sheets of sheer material 100 and 102, an adhesive or thread could also be used to attach the vanes 104 to one or both of the first and second sheets of sheer material 100 and 102.

The window covering 82 is fed into the device 80 such that a leading edge 114 of the first sheet and a leading edge 116 of the second sheet are the first to enter into the device 80.

The device 80 for relieving stress in the window covering 82 comprises a tentering frame 36 for "grabbing" the window covering 82 and carrying it along the length of the device 80. As can be seen in FIGS. 1 and 2, the tentering frame 36 has left and right sides 44 and 46 and runs at least from a first axle 72 of the tentering frame 36 to a second axle 74 of the tentering frame 36. The tentering frame 36 runs in a conveyor type fashion, carrying the window covering 82 from the first axle 72 to the second axle 74 of the tentering frame 36. As can be seen in FIGS. 3 and 10, the tentering frame 36 includes a plurality of pins 64 that are generally equally spaced along the left and right sides 44 and 46 of the tentering frame 36. The pins 64 are used to grab the window covering 82 and carry it along the length of the tentering frame 36.

In one embodiment of the invention and as shown in FIG. 6, the pins 64 are located on the left and right sides 44 and 46 of the tentering frame 36, wherein the pins 64 on the left side 44 of the tentering frame only contact the first sheet of sheer material 100, while the pins 64 on the right side 46 of the tentering frame 36 come into contact with only the second sheet of sheer material 102.

As shown in FIG. 3, the window covering 82 comes into contact with the individual pins 64 on the tentering frame 36 shortly after entering the device 80. In order to adequately position the window covering 82 for smooth and efficient contact with the pins 64, a first idler 86 is coupled to the outside of the system frame 84 of the device 80. Depending upon the relative feed angle of the window covering 82 into the device 80, however, it may be possible to locate the first idler 86 in a different position or not use a first idler 86 at all.

As can be seen in FIGS. 2, 4 and 5, the distance between the left side 44 and the right side 46 of the tentering frame is not constant throughout the length of the tentering frame 36. Rather, the

distance between the left side 44 and the right side 46 increases along the first portion of the machine. This increase in distance causes a tension to be applied to the window covering 82 in a direction substantially perpendicular to the pathway 20 along which the window covering 82 is fed into the device 80. FIG. 12, for example, shows a cross sectional view of the window covering 82 as it first enters the device 80, wherein the individual vanes 104 have a certain degree of flexibility and are not under tension. FIG. 13 shows the same window covering 82 as tension is applied, wherein the first sheet of sheer material 100 and the second sheet of sheer material 102 are pulled in substantially opposite directions, causing the individual vanes 104 to become taut relative to the first and second sheets of sheer material 100 and 102. FIG. 14 shows a portion of the window covering 82 in the fully tensioned position.

Also shown in FIG. 3 is an individual piston unit 77 which is coupled to the first axle 72 of the tentering frame 36. The piston unit allows the first axle 72 to have its position altered relative to other components of the device 80 depending upon the particular needs at the time.

As can be seen in FIG. 1, a plurality of nip units 30, 32 and 34 are located along the pathway along which the window covering 82 travels through the device 80. According to one embodiment of the invention, each of the individual nip units 30, 32 and 34 comprise a nip cylinder 52 that is coupled to a swing arm pivot 54. The swing arm pivot 54 is coupled to a nip idler roll 56 which cooperates with a nip drive roll 58 to press against the window covering 82. In one embodiment of the invention, each nip drive roll 58 is powered by a nip motor 48 via a nip chain 50. The use of multiple nip units 30, 32 and 34 allows for a tension to be applied to the window covering 82 in a direction

substantially parallel to the pathway by which the window covering 82 is fed into the device 80. More particularly, a desired tension is applied between the first and second nip units 30 and 32, and a different tension can be applied between the second and third nip units 32 and 34.

The operation of the device 80 is generally as follows. The light control window covering 82 is fed through the first idler 86 onto the pathway 20. The first idler 86 allows the window covering 82 to be fed into the device 80 at a particular angle, allowing for a smooth contact with the pins 64 on the tentering frame 36. In a preferred embodiment of the invention, the window covering 82 is manufactured immediately before entering the device 80. In an alternate embodiment of the invention the window covering 82 is wound up in a roll and is subsequently unwound before entering the device 80.

After passing through the idler 86, the window covering 82 comes into contact with the tentering frame 36 at a point adjacent to the first axle 72, with the first and second sheets of sheer material 100 and 102 being "grabbed" by the pins 64 on the left and right sides 44 and 46 of the tentering frame 36. The tentering frame 36 is powered by a combination motor 82 and drive belt 84. In one embodiment of the invention, the motor 82 and drive belt 84 are located and interact with the second axle 74. The motor 82 and drive belt 84 cooperate with the second axle 74 to move the tentering frame 36 in a substantially clockwise direction as shown in FIGS. 1 and 3, carrying the window covering 82 along the path 20.

Once contacted by the pins 64, a tension is applied to the window covering 82 along a direction substantially perpendicular to the pathway 20 (towards the left side 44 and the right side 46 of the tentering frame 36). This is accomplished by a widening of the space between the left side 44 of the tentering frame 36 and the right side 46

of the tentering frame 36. More particularly, the beginning of the tentering frame 36 includes a left outward portion 66 and a right outward portion 68. As the window covering 82 passes across the left and right outward portions 66 and 68, the window covering is tensioned by the "pulling action" on the first and second sheets of sheer material 100 and 102.

After the window covering 82 is fully tensioned in the direction substantially perpendicular to the pathway 20, the window covering 82 passes through a first nip unit 30 located along the pathway 20 after the left and right outward portions 66 and 68. The first nip unit 30 cooperates with the second nip unit 32 located further along the pathway, acting to effectively pin the window covering 82 at different points. This pinning action results in a tension in a direction substantially parallel to the pathway. The combination of the first and second nip units 30 and 32 and the tentering frame 36 result in the window covering being tensioned in two directions that are substantially perpendicular to each other.

After passing through the first nip unit 30, the window covering 82 passes between a set of upper heating elements 22 and a set of lower heating elements 24, shown in FIGS. 1, 7 and 8. The upper and lower heating elements 22 and 24 cooperate to provide a controlled amount of heat to the window covering 82. This heating action removes creases, wrinkles or puckers that may have been formed during the manufacturing process of the window covering 82 or during subsequent storage or handling of the window covering 82. In one embodiment of the invention, the window covering 82 is heated at a relatively low temperature such that the window covering is not heat set per se, but instead is only heated to a temperature sufficient to relieve stresses in the window covering 82 that cause creases or puckers. It is also possible,

however, to heat the window covering 82 at a sufficiently high temperature such that heat setting does take place.

In one embodiment of the invention and as shown in FIG. 2 the set of upper heating elements 22 comprises a left upper heating unit 38, a center upper heating unit 40 and a right upper heating unit 42. Similarly, the set of lower heating elements 24 comprises left, center and right lower heating units (not shown). The use of multiple heating units allows for improved control over the heating process, when the amount of heat supplied by a particular heating can be increased or decreased depending upon the particular requirements. This enables a user to apply a more uniform heat treatment to the entire window covering 82.

As shown in FIGS. 1 and 7, the set of lower heating elements 24 is surrounded by a platen 26 upon which the window covering 82 will travel when passing between the sets of upper and lower heating elements 22 and 24. The platen 26 provides the function of giving a surface for the fabric to ride upon and to even distribute the heat and transfer the heat to the fabric through contact. In a preferred embodiment of the invention, the platen 26 will be made of a conductive material, although various types of materials may be used depending upon the particular requirements of the user.

According to one embodiment of the invention, both the sets of upper and lower heating elements 22 and 24 are coupled to upper and lower lifting cylinders 60 and 62 respectively. The upper and lower lifting cylinders 60 and 62 allow for the sets of upper and lower heating elements 22 and 24 to be repositioned relative to the window covering 82 depending upon the particular needs. For example, in the event that the tentering frame 36 malfunctions and is stopped moving the window covering 82 along the pathway 20, the upper and lower lifting cylinders 60 and 62 could be used to move the upper and lower heating elements

20 and 22 away from the window covering 82, preventing damage to the window covering 82. Alternatively, the upper and lower lifting cylinders 60 and 62 could be repositioned, in combination with changing with the heat output of the sets of upper and lower heating elements 22 and 24, to more accurately control the amount of heat that is applied to the window covering 82.

After the window covering 82 passes between the sets of upper and lower heating elements 22 and 24, the window covering passes through the second nip unit 32. According to one embodiment of the invention and as shown in FIG. 1 a third nip unit 34 is located further along the pathway. This allows for the tension to be adjusted in the direction substantially parallel to the pathway 20 for subsequent treatments to the window covering 82.

After passing through the second nip unit 32 the window covering 82 enters a region that includes a cooling section. By cooling the window covering 82 or other fabric while it is still under tension, puckers, creases, or other imperfections are much less likely to be formed in the fabric than would occur if the fabric was not tensioned during cooling. In one embodiment of the invention, the window covering 82 enters a region that includes a plurality of fans 28, shown in detail in FIG. 9. The plurality of fans 28 draw heat away from the center of the device 80 helping to maintain a relatively constant temperature inside the device 80. In one embodiment of the invention, one fan 28 is located on each of the left and right sides of the device frame 84, where one fan 28 is coupled to the top of the device frame 84.

After passing through the third nip unit 34, the window covering 82 reaches the second axle 74 of the tentering frame 36. At this point the tentering frame 36 cooperates with a second idler 88, coupled to the device frame 84, for disengaging the window covering 82

from the tentering frame 36. More particularly and as shown in FIGS. 1 and 10, the second idler 88 is positioned such that the window covering 82 continues to travel along a relatively straight path even after it leaves the tentering frame 36. This allows the first and second sheets of sheer material 100 and 102 to be "lifted" off of the pins 64 as the tentering frame 36 continues to rotate in a clockwise direction. After the window covering 82 passes through the second idler 88, it exits the device 80 and can then either be wound or sent to another device for a subsequent manufacturing process.

A further advantage of the present invention is that, in addition to removing undesired creases from the window covering 82, the device 80 also provides the function of strategically adding one or more creases to the window covering as desired. For example and as shown in FIG. 12, a portion of each vane 104 is folded over itself in the region that contacts the second sheet of sheer material 102. The combination of the tension applied by the tentering frame 36 and the heat application will form a crease in this region of the vane 104, which can be desirable depending upon the design and manufacturing preferences. Depending upon the particular arrangement of the window covering 82, it may also be possible not to impart any creases into the window covering 82 during the stress relieving process.

In an alternate embodiment of the invention, shown in FIG. 15, a secondary conveyor belt 70 may also be used to help carry the window covering 82 along the pathway 20. Because the window covering 82 is typically contacted by pins 64 only along the left and right sides of the tentering frame 36, the center portion of the window covering 82 will have a tendency to drag behind the left and right sides thereof. This dragging action could cause difficulties in removing creases or puckers from window covering 82.